1903MNRAS..63..400J

Observation of the Partial Eclipse of the Moon, 1903 *April* 11. By E. M. Antoniadi.

The weather was fine here on the night of April 11, so that the observations of the eclipse were made under favourable circumstances, the instrument used being a 3-inch achromatic, power 35.

Soon after first contact with the umbra it became evident that a "black eclipse" was developing, the shadow being so dark as to utterly blot out the limb and all topographical details of the lunar surface. As usual, however, the edge of the umbra was transparent: all along a zone extending 3′ from the border inwards, the shadow was of a diaphanous ash-grey colour, in which tinges of green, blue, and violet were alternately and repeatedly suspected.

It was only towards midnight, G.M.T., that by sweeping with the telescope right and left of the Moon, in order to gain contrast, the whole body of our satellite was seen projected as a brownish-black disc on the scarcely darker background of the sky. But to the unaided eye the eclipsed portion remained invisible.

This is the only instance, since 1887, in which I could not see the shaded limb without optical assistance. On 1891 November 15 and 1892 May 11 the colour of the shadow was of a very decided coppery red, brightening to a beautiful roseate hue near the centre of obscuration; and a comparison of these, and other impressions on past eclipses, with the recent "black eclipse" shows how the shadow can vary in colour from rose to black, and how great an interest attaches to the observation of these phenomena.

74 *Rue Jouffroy, Paris:*
1903 *May* 6.

A Possible Cause of the Moon's Obscurity on April 11. By the Rev. S. J. Johnson, M.A.

The ordinary course of an immersion of the Moon in the Earth's shadow is so uniform as to gradations of colour and other matters that it would be useless to occupy space concerning it. On the late occasion, however, the blackness of the Moon's surface was of such an intense character as only seems to have been noticed twice in England in the last century, viz. in 1816 and 1884, and once, in Tasmania, in 1885.

As the curved shadow advanced the appearance was, as usual, that of a dark bar across the S.E. portion of the Moon.

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At 11.50, when the whole of the Mare Crisium had just become immersed in the shadow, this was the first and only object I was able to make out in the telescope, and it disappeared in a few minutes. A rim of light greenish-grey extended inwards 4′ from the enlightened crescent. To the naked eye the small bright crescent gave one the impression of being much brighter than it really was, probably owing to irradiation. At 12.0 the whole globe of our satellite could be discerned in the telescope, appearing of a dull faint brown colour. At $12^h\ 10^m\ 52^s$ a faint star, probably B.D. −8°, 3543, disappeared nearly at the lowest point of the disc, and $12^h\ 22^m\ 42^s$ may be taken as the time of emergence of a star, probably B.D. −8°, 3540. At the time of greatest phase, 12.13, and during the retreat of the umbra the eclipsed part of the Moon's disc was entirely of a blackish grey, not a trace of detail being visible.

The usually received explanation of this is the state of the several strata of the atmosphere with regard to transparency or with regard to saturation. On the other hand, if we take the two instances seen in our own land in the last century, 1816 was one of the wettest summers on record, and the eclipse of 1884 October 4 took place after a remarkably fine and dry summer and autumn. They happened, therefore, under directly contrary circumstances as regards meteorological conditions. The eclipse of 1884 taking place a year or so after the Krakatoa explosion, and the late one having happened after the West Indian eruption, it is difficult not to connect the two in some way as cause and effect.

If we go backwards to former occasions of abnormal darkness of the eclipsed Moon, such instances seem to have taken place a year or two after volcanic disturbances.

The eclipse of 1816 June 10 was two years after the eruptions of Mayon (Philippine Islands) mentioned by Arago. The following, however, from the *American Almanack* for 1833, p. 70, is perhaps more to the point:—

"1814 July 3 and 4. Great fall of black dust in Canada with appearance of fire. This event was similar to that of 472.—*Phil. Mag.* vol. xliv.

"1815. Towards the end of September. The sea south of India was covered to a great extent with dust.—*Phil. Mag.*, 1816 July.

"1816 April 15. Red snow in different parts of the northern region of Italy."—*Giornale di Fiscia*, &c., t. 1, 1818, p. 473."

The previous instance of a disappearance of the Moon occurred on 1761 May 18, observed by Wargentin at Stockholm, who says that "not the slightest trace of any portion of the lunar disc could be discerned either with the naked eye or with the telescope." This took place after a noted volcanic disturbance. Arago, *Popular Astronomy*, vol. ii., art. The Earth, p. 97, says: "The catastrophe which gave birth to the volcano of Jorullo (Mexico) is perhaps, says M. Humboldt, one of the most extra-

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ordinary physical revolutions which the annals of our planet offer. In the midst of a continent, at a distance of thirty-six leagues from the sea coast and forty-two leagues from any active volcano, a tract of land of about twelve square kilometres was upheaved in the form of a bladder during the night of 1759 September 28–29. In the centre of a multitude of ignited cones there suddenly arose six mountains of from 1,300 to 1,600 feet above the original level of the neighbouring plains. The principal mountain, the volcano of Jorullo, has an altitude of 1,696 feet. Its eruptions continued without intermission down to the month of 1760 February."

We may well suppose that the volcanic dust in so similar an eruption to those of Krakatoa and Mount Pelée had travelled to the atmosphere of the Scandinavian peninsula by the time of the eclipse.

The previous instance seems to have been in 1642 April mentioned by Wendelinus. Arago remarks: "The Tunguragua made an explosion in 1641," also (speaking of the Philippine Islands), "Aringuay made an eruption in 1641."

As to the cases of 1620 and 1601, I have not hitherto noticed any account of previous volcanic action, but we may well believe such to have taken place, as it cannot be expected that all the eruptions in the Pacific were recorded at that date.

Wendelinus (*Eclipses Lunares*) speaks of another case of darkness of the eclipsed Moon, "a matter that Tycho has left in writing about the eclipse of 1588," and Arago says, "The two peaks, very close to each other, called the Fuegos de Guatemala, experienced terrible eruptions in the year 1586.

Something may therefore be said in support of the conjecture that the presence of volcanic dust in the upper regions of the air may be connected with the obscurity of the Moon's surface on the occasions referred to.

Melplash Vicarage, Bridport: April 18.

Eclipse of the Moon of 1903 *April* 11, *observed at the Royal Observatory, Greenwich.*

(*Communicated by the Astronomer Royal.*)

In addition to observation of occultations, preparations were made to observe the times of transit of the first and second limbs of the Moon in order to compare the diameters as found from bright and dark limbs respectively. For this purpose additional wires were inserted in the Merz refractor (aperture 13 in.) and in the guiding telescope (aperture 10 in.) of the astrographic

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